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EPISTEMIC STYLES, RULES & WORLDVIEWS

by

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ABSTRACT

Psychological epistemology is the study of how individuals differ in their ways of knowing. The present effort presents the results of empirical studies carried out within the conceptual framework of psychological epistemology as developed by J.R. Royce. This involves the study of individual differences in psychological worldviews (the individual's total organization of reality); epistemic styles (the behavioral manifestations of differences in knowing); and epistemic rules (the decision criteria underlying differences in knowing). Data relating epistemic styles to academic specialization and vocational interests are presented in support of the hypothesized relationship between worldviews and epistemic styles. A simulation model demonstrating the effects of epistemic rules on the acquisition of information is discussed and compared to human performance in an information processing task. Further work in and potential applications of psychological epistemology are discussed.

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I. INTRODUCTION.

Epistemology is the study of knowledge--its nature, origins, and limits. Psychological epistemology is the study of individual differences in knowing. The psychological focus is upon knowing as a process rather than knowledge as an abstract state or structure. Moreover, psychological epistemology is concerned with a descriptive rather than normative study of knowledge. That is, the focus is upon the description of specific knowing processes rather than an evaluation of the validity of knowledge claims in general.

Royce (1964; 1974b) has developed a conceptual framework for the study of psychological epistemology. This framework approaches epistemology from a personality/trait theory perspective in contrast to a social/historical one (e.g. Campbell, 1960). Royce postulates that individual differences in knowing must consist of two aspects; distinguishable truth criteria and uniquely associated cognitive processes. Thus, according to Royce, if individuals differ in their "ways of knowing", they must differ in both respects--truth criteria and cognitive processes.

Royce (1974a) has suggested the following three ways of knowing:

Rationalism. A truth criterion based on logical consistency. Something is true if it is logically consistent with the rest of our knowledge and false if it leads to contradictions. The underlying cognitive processes are those of thinking: the formulation, elaboration and use of concepts.

Empiricism. A truth criterion based on external experience and observation. Something is true if it corresponds to some external reality. The underlying cognitive processes are those of perception and sensation.

Metaphorism. A truth criterion based upon the universality of metaphoric awareness or insight. Something is true if it transcends space and time and false if it is unique or idiosyncratic. The corresponding cognitive processes are those of symbolizing.

Because every individual perceives, conceptualizes, and symbolizes, each individual must manifest all three ways of knowing.[1] However, it is suggested that most individuals are dominated by a particular truth criterion

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1. It is not claimed that these three ways of knowing are the only possible psychological epistemologies. It is claimed, however, that there are <u>at least</u> these three distinct ways of knowing and that the traditional epistemologies are reducible to a specifiable combination of rationalism, empiricism, and metaphorism. It is also possible that there are other cognitive modes (perhaps unknown at present) which correspond to a particular valid epistemology--the present theorizing in no way precludes this possibility.

and its corresponding major cognitive process which is a characteristic or preferred mode of knowing. Analogous to other personality styles, characteristic or preferred modes of knowing are termed epistemic styles. Each individual is assumed to have an epistemological hierarchy which consists of a specifiable hierarchy of the three epistemic styles. The implication is that the dominant epistemic style has the major influence on the way the individual seeks and organizes knowledge. Thus an individual with a rationally dominant epistemology seeks out information which can be conceptualized and organized according to logical consistency; an individual with an empirically dominant hierarchy leans to perceptual experience and a knowledge system based upon external reliability; and a metaphorically dominant individual tends to seek information which possesses symbolic significance.

Epistemic styles can be objectively measured by the Psycho-Epistemological Profile (PEP). The PEP is a 90 item questionnaire which has 30 items corresponding to each of the three epistemic styles. An individual is asked to agree or disagree with each item on a 5 point Likert scale. After completing the inventory, the individual has a score between 30 and 150 on each of the three scales. The ordering of the scores on the three scales is taken as refecting an individual's epistemological hierarchy. A

complete discussion of the adminstration and scoring procedure is given in the test manual (Royce, Mos & Kearsley, 1975).

Empirical research using the PEP provides construct validity for the three epistemic styles. Past research has demonstrated characteristic differences in epistemological hierarchies between sexes, different value orientations, different academic disciplines, psychotherapy orientations, and cultures. The PEP has been standardized and satisfies reasonable criteria for reliability.[2] A full discussion of previous work with the PEP is given in the manual.

Epistemic styles are the behavioral manifestations of individual differences in ways of knowing. The PEP provides an objective indicator of such differences. However, the present effort is not directly concerned with either epistemic styles or the PEP but rather with two theoretical elaborations of epistemic styles; epistemic rules and psychological worldviews. Epistemic rules describe decision or selection criteria for determining if new information is to be accepted or rejected as valid personal knowledge. They constitute attempts to specify the details of the cognitive processes and truth criteria

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2. A study conducted by the writer to assess the face validity of the PEP is reported in the Appendix.

which underlie each of the three epistemic styles. The notion of an epistemic rule is introduced and discussed in detail in the next chapter. A psychological worldview is the individual's total organization of reality and determines the way in which knowledge is organized and sought. The chapter following epistemic rules discusses the conceptualization of worldviews in terms of epistemic styles and some empirical evidence which illustrates these ideas.

It will perhaps clarify the following discussion if the theoretical relationships between the three major constructs are explained beforehand. Epistemic styles are the behavioral manifestation of individual differences in knowing and , hence, are the primary empirical focus. Underlying epistemic styles are the cognitive processes described as epistemic rules which determine how information is processed and hence behavioral manifestations. On the other hand, epistemic styles determine an individual's total organization and acquisition of knowledge and therefore that individual's approach to reality. Thus, both epistemic rules and psychological worldviews are inferred from epistemic styles. This is depicted in Figure 1. This means that both the constructs of epistemic rules and psychological worldviews depend upon the demonstration of empirical relationships with epistemic styles for their theoretical

viability.

Figure 1 also shows a relationship from worldviews to rules. This is meant to suggest that the way an individual organizes and seeks new knowledge may in turn affect the cognitive processes involved in organizing and acquiring the knowledge. Such changes in epistemic rules will then bring about changes in worldviws. This is analogous to Piaget's notions of accomodation and assimilation. However, the relationship from rules to worldviews has an empirically observable connection (namely epistemic styles) while the worldview-rules relationship is a theoretical linkage. The following chapters focus more on former than the latter.

II. EPISTEMIC RULES.

In this chapter we will focus on epistemic rules which describe decision or selection criteria for determining if information is to be accepted or rejected as valid personal knowledge. As such, they are concerned with both epistemic norms and the cognitive operations involved in making decisions or selections. Before discussing one possible set of epistemic rules in detail, a few preliminary remarks on the general concept of rules are in order.

A rule, in the current usage of cognitive psychology, is a procedure which achieves a certain end-state or goal. It consists of a set of operators which transform some input into an output. In the context of information processing theory, these basic operations involve the manipulation of symbols, e.g., deletion, catenation, insertion, replacement, etc. Such basic operations can be combined to form rules for explaining the mechanisms involved in cognitive processes such as problem solving, concept learning, reasoning, memory storage and retrieval, etc. Thus, a set of rules provides an explanation for some cognitive activity in so far as it provides a set of procedures which are functionally equivalent to the actual cognitive processes.

To give a simple example, consider the simple task of

letter sequence extrapolation which is a common ability test (e.g., Thurstone, Guilford). In this task the subject is presented with a sequence of letters followed by one or more blanks and is asked to provide the next letter(s). To extrapolate the sequence the subject must induce the rule underlying the sequence and use it to generate the next letters. A simulation model (Simon & Kotovsky, 1963) using only the three basic operators of next, same and last symbol, can accomplish this task and match human performance. This suggests that the actual problem solving process could also involve such simple operations (see Simon & Kotovsky, 1963, for details).

The fact that a small, finite set of operations can be used to account for an essentially infinite number of rules and hence behaviors, is one of the powerful theoretical aspects of rule constructs. This is most clearly demonstrated in formal linguistic grammars where a small set of rewriting rules together with an alphabet can generate an infinite number of sentences. Thus, rule-based explanations allow for an account of complex cognitive activities on the basis of relatively simple primitive operations.

A second important feature of a rule is that it must involve some type of evaluative component which constitutes the goal conditions of the rule. Thus, rules

have the canonical form:

IF comparison THEN x

where the IF portion is a test to see if the conditions of the rule are satisfied and the THEN specifies the operation to be performed if the test condition is satisfied. Moreover, rule sequences can easily be built into hierarchial structures where the condition of one rule is the x of another rule. This is most clearly brought out by Miller, Galanter, & Pribram (1960) in their TOTE (test-operate-test-exit) unit. Consider their example of hammering a nail into a piece of wood. The general description of hammering involves a conditional test: IF nail is up THEN hammer. However, the THEN hammer portion of this rule can be replaced by another conditional rule: IF hammer down THEN lift. One could go further with this example by replacing the THEN clause with yet another. The important point is that sequential actions can be explained by an underlying hierarchial organization of rules.

Yet a third cogent point about rules is that the range of application of a rule is to a set or class of input (stimuli) and output (responses). Thus rules are inductively generated from one or more examples and then applied to a class of input. Similarly, output may be a class of responses to a single input. This is contrasted to any type of s-r associationism in which specific input-

output relations are necessary. To use a rather baroque example, what the rat in the skinner box learned was not a stimulus-response contingency but rather a rule about pressing bars (e.g., IF bar press THEN food). Thus, pressing the bar with a tail, paw, nose, etc., constitute a class of responses all covered by the same general rule. This also brings out the close relationship between concepts and rules in that they both constitute equivalence classes.

Finally the most interesting and perhaps compelling aspect of rules is that they are ubiquitous. This is true at both common sense and technical levels. At the common sense level we have rules such as:

IF light is green THEN walk

IF raining THEN take umbrella

IF pencil is dull THEN sharpen it

IF back itches THEN scratch it

...etc...

At a more technical level, we have implicit cognitive rules in all cognitive activites, e.g., arithmetic, language & speech, pattern recognition, problem solving, concept learning. The fact that you can add two numbers which you have never seen before suggests there exists a rule for addition; the fact that having seen a novel string of printed characters, you can recognize this string in any form of script or writing suggests that

there exists a rule for recognizing patterns; the fact that you can correctly pronounce the pluralized ending of a never before pronounced word suggests things such as morphophonemic rules; the fact that having solved a number of problems of one type, we persist in that solution suggests we have learned a solution rule (so called "mental set"); the simple fact that having been told what constitutes a concept of some sort, we can then classify instances and non-instances of that concept with absolutely no learning suggests that concepts are basically rules; and so on.[3]

The Idea of an Epistemic Rule

Epistemic styles are characteristic or preferred modes by which individuals relate new experiences, observations, or facts to what they already know. If we view the knowing process as a continual reorganizatien of a hierarchially organized knowledge structure (a plausible assumption from psychological studies of memory), then the three epistemic styles specify different ways in which this network can be reorganized or enlarged. Thus, each epistemic style corresponds to a set of transformations or

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3. These brief remarks on rules are only introductory in nature and do not attempt to fully consider the metatheoretical issues in rule-based explanation. Such discussions are given by Segal & Stacey (1975) , Scandura (1970), Dulany (1968), and Kearsley (1976a).

decision rules for reordering old information and merging new information with old. These rules are essentially concerned with deciding whether new information is acceptable according to the different epistemic criteria.

Figure 2 illustrates three prototype rules corresponding to the three epistemic styles. These are prototypic because there are really a set of rules associated with each, however as a first step it seems reasonable to concentrate on these "pure" forms. It should be borne in mind that these rules abstract one particular aspect of the epistemic style they represent. Thus, the rule representing rationalism rejects any input which contradicts information already known and accepts that which is logically consistent. This leads to a knowledge structure based either on coherency or consistency. The rule representing empiricism accepts information which agrees exactly with information already possessed (i.e., it replicates or corroborates information) and rejects new information which does not. The resulting knowledge structure consists of classes of information which have been highly confirmed or consensually validated. This is taken to be the essence of sensory or perceptual functioning. The rule representing metaphorism accepts new information when it further extends something already known and rejects it if it does not. The type of knowledge structure derived from the "metaphoric" rule is one in

which information is similar in some way, e.g., rhymes, synonyms, analogies, metaphors, etc.

In the pure forms just described, application of these epistemic rules would lead to three mutually exclusive classes of knowledge structures. In fact, the strict application of the empirical and metaphorical algorithm would result in a knowledge network consisting of essentially one component--the initial input. There are two reasons why this does not occur. First, acceptance of input as truthful is taken to correspond to placing that knowledge at the "bottom" of the knowledge network. The assumption is that knowledge at the bottom of the network provides the support for the rest of the network, that is the basis or core. Conversely, information which is rejected as false is placed at the "top" or periphery of the network. Because such information could become knowledge on the basis of later new information (via one of the three rules), it could move from the periphery to the basis of the network. On the other hand, rejected information which is never validated remains at the periphery of the network. Thus, truth-falsity has been treated as a graduated rather than dichotomous state in the model. Moreover, truth-falsity is a relational property of the network rather than something attached to each individual fact or proposition. This seems reasonable in so far as knowledge is not incorrigible, i.e. something

which is known can be doubted or possibly become false if the contextual relations are altered.

The second reason why these "pure" rules do not lead to exclusive classes of knowledge is because an epistemological hierarchy includes all three epistemic styles in one of six possible dominance relations and hence these rules can interact in the acquisition of knowledge. As a first approximation to this interaction and one which can be justified in terms of information processing theory (c.f. Newell & Simon, 1972, pp. 796), it is assumed that these epistemic rules are applied in a serial order which corresponds to their order in an individual's epistemological hierarchy. For example, if an individual has a metaphorical-rational-empirical hierarchy (MRE), the incoming information is initially processed according to the metaphoric rule, then the rational rule, and finally the empiricial rule. Hence the reorganization of the knowledge structure after application of one rule is the input for the application of the next rule. The interesting question is whether this type of procedure will lead to different resultant knowledge structures given different epistemological hierarchies. In order to investigate this question and the notion of epistemic rules in detail, a computer simulation model was designed.

A Simulation Model

The model was written in LISP 1.5, a programming language designed for the symbolic processing of list structures. LISP is based upon a mathematically concise notation for the recursive definition of symbolic expressions (see McCarthy, 1965). In LISP, input and output takes the form of lists of atomic symbols, an atomic symbol being a basic unit which cannot be further subdivided. Thus, in the list :

(THIS IS A LIST OF ATOMS)

each word constitutes an atomic symbol. However, lists can also contain other lists, such as:

((THIS IS A LIST) (AND SO IS THIS)

(AND THIS (TOO)))

Moreover, lists can be hierarchally organized so that one list is supraordinate to others. It is assumed that a knowledge structure can be represented as such a set of hierarchially arranged list structures. In the following discussion, it should be borne in mind that the term list refers to hierarchial tree structures rather than linearly ordered lists.

Although the program consists of a number of LISP functions , I will only discuss the four major ones that are of psychological interest. The three functions EMPO(x), RATIO(X) and METO(x) rearrange their arguments,

x, according to the three epistemic rules which were depicted in Figure 1. EMPO groups all exactly matching lists in x together at the front of its permanent list. Thus with continued input, those items at the front of this list have occurred often while those at the end of the list are infrequent. METO groups together all lists in x which contain alike atoms or sublists at the front of the permanent list and moves those which do not share any atoms or lists to the end of the permanent list. With more information, the assertions at the front of the list share many embedded atoms or lists while those at the end of the list are completely unrelated and idiosyncratic. RATIO moves all of the atoms or lists in x which involve explicit contradictions (e.g., (FISH SWIM) and (FISH DON'T SWIM)) to the end of the permanent list. Thus if the list (FISH SWIM) already existed and the incoming assertion was (FISH DON'T SWIM) both assertions would be removed to the end of the list. Eventually all of the assertions at the front of the list are free from logical contradiction, while all of those at the end are contradictory. The function KNOWING(style1,style2,style3,x) applies style3 to the list, x, then style2 to the result of this reorganization, and style1 to this result. The ordered triplet (style1,style2,style3) corresponds to one of the six possible epistemological hierarchies. To illustrate, the statement:

KNOWING (METO,EMPO,RATO, (JOHN SWIMS) (JOHN DOESN'T SWIM)
(JOHN SWIMS) (BIRDS FLY) (FISH SWIM))

corresponds to a metaphorical-empirical-rational hierarchy. It would involve the initial application of RATIO to x giving:

((BIRDS FLY) (FISH SWIM) (JOHN SWIMS)
(JOHN SWIMS) (JOHN DOESN'T SWIM)))

in which the contradictory assertions (JOHN SWIMS) and (JOHN DOESN'T SWIM) have been moved to the end of the list. The application of EMPO to the above list gives:

((JCHN SWIMS) (JOHN SWIMS) (BIRDS FLY)
(FISH SWIM) (JOHN DOESN'T SWIM)))

Thus, the two assertions which exactly match, (JOHN SWIMS), are grouped together at the front of the list. Finally the application of METO results in:

((FISH SWIM) (JOHN SWIMS) (JOHN SWIMS)
(JOHN DOESN'T SWIM) (BIRDS FLY)))

in which the list has been reorganized so that those assertions sharing the same item, SWIM and JOHN, have been grouped together at the front of the list and the assertion which is unique (BIRDS FLY) is at the end of the list. Again let me point out that this is really a hierarchial network rather than a linearly ordered list and being at the front of the list corresponds to the bottom of the network while the end of the list corresponds to the top of a network.

An Experimental Comparison

Since it is intended that there is some functional similarity between the epistemic rules as simulated and the actual cognitive processes involved in knowing, the performance of the model was compared with human performance. To do this it is necessary to find a suitable task. The task chosen involved the rearrangement of nonsense sentences (i.e. sentences containing minimal semantic information). Nonsense sentences were chosen over meaningful material in order to guarantee that the information would be novel (and hence qualify as a task of acquiring new information) and because the program has no facility for handling semantic associations and meaning.

Eight introductory psychology students (participating for course credit) were given the PEP to determine their epistemological hierarchies. They were then given, one at a time, the five sets of nonsense sentences indicated in Table 1 and asked to rearrange them in some order which "made sense to them". The point of such ambiguous instructions was to avoid providing an obvious bias in the way they should process information. They were also instructed to concern themselves only with the relationships within each set and not with any between set relationships.

The rearranged order for each set was ranked

according to its change from the initial random order given. The same sentences[4] , in the same initial orders were rearranged by the program for each of the six possible epistemological hierarchies and also ranked according to the change from the initial order. Table 2 illustrates the six different rearrangements corresponding to the epistemological hierarchies for the sentences of set 4, where R indicates rationalism, E indicates empiricism, and M indicates metaphorism. As can be seen from this table, the final reorganized list from the same initial input differs for some of the hierarchies. Whether the output of the six hierarchies is identical or completely different obviously depends upon the relational characteristics of the input assertions.

The comparison between program and human performance is presented in Table 3. The measures of comparison are Spearman rank correlation coefficients which indicate the the degree of correspondence between the final ranked order for each set of sentences rearranged by the subjects and that of the corresponding simulated epistemological hierarchy. To summarize the results, the program significantly matched the performance of all subjects on set 3 (which contains no negations); some of the subjects

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4. It should be noted that while these were sentences for the subjects, to the program they were lists of atoms.

on sets 2 and 4; and only one subject on sets 1 and 5. This indicates that there are some inadequacies in the current program as a model of knowing processes for certain types of information.

These inadequacies may come from a number of sources. First, the epistemic rules upon which the simulation model is based are prototypical and really represent sets of rules. Given individuals with prototypical epistemologies (e.g., "pure" types), these rules may match well. However, for the model to satisfactorily model most individuals, these prototypical rules would need to be replaced by more fine-grained sets of rules. Thus we would need a set of rules for rationalism which explicate the different ways in which concepts can be formed, elaborated, assimilated into others, etc., and the different ways in which one concept can be deduced from another. The present rational rule takes these operations for granted and focues solely on the logical comparison of symbol strings (which is a critical aspect of rational thinking). Furthermore, there may be different ways in which one concept can contradict another, e.g., logical contradiction (standing or not standing) vesus semantic contradiction (sitting versus standing).

Similarly, we would expect detailed epistemic rules for empiricism and metaphorism. The present rule for

empiricism focuses on the operation of exact replication (which is taken to be an essential aspect of perceptual invariance) but does not account for any of the distinctly perceptual or sensory operations underlying empiricism and perceptual error e.g., illusions. A set of rules corresponding to the Gestalt "laws" (e.g., continuity, closure, symmetry, etc.) would likely be necessary to adequately represent the processes underlying empiricism. The present metaphorical rule singles out the operation of shared symbols (which is considered to be an essential aspect of metaphoric thinking). A set of metaphoric rules would need to capture the various nondiscursive types of processing made in analogies, metaphors, similes, jokes, etc. For example, it is expected that rules corresponding to the ability to assess the information complexity of a percept or cognition in terms of aesthetic import would be important.

The three idealized rules explored in the present model do not attempt to elaborate on the detailed set of rules which might correspond to each epistemic style. Nor is there any attempt to specify the operations which comprise these rules. To be completely adequate, it would be necessary to provide the rules and operators which reflect the full range of processes involved in conceptualizing including the operations of concept formulation, elaboration comparison, etc. Similarly, we

would need to establish a set of rules corresponding to the perceptual-sensory aspects of empiricism and the symbolic processes involved in metaphorism. The present model does not attempt to do this.

A second problem with the present model is its inability to match epistemic styles in a quantitative fashion. The PEP gives scores which indicate the degree to which one epistemic style is different from the others; however, in the present model they were simply treated as ordered scales. Thus, in the program, an individual who has a high score on a paticular epistemic style but much lower scores on the other two scales would have the same simulated hierarchy as an individual who differs slightly in the differences between epistemic styles. The fact that the model does quite well on a list which lacks negations suggests that the rational epistemic rule is too narrow in its restriction to logical contradictions and should be modified. Finally, despite the use of nonsense sentences, even these may have subtle semantic associations which the program has no facility for understanding.

With all these limitations and qualifications, the conclusion might be drawn that the present model is of little interest. This would be an inappropriate conclusion to draw for a number of reasons. The model powerfully demonstrates how different modes of reorganizing

information can result in different knowledge structures beginning with the same initial information. This provides a concrete demonstration of how very simplified rules, analogous to those used in cognizing, could result in quite different knowledge structures and hence views of the world.

The notion of epistemic rules also relates well to current work in cognitive psychology. Several recent attempts (Egan & Greeno, 1974; Simon & Lea, 1974) have been made to show that the construct of rules, suitably explicated, can be used to explain major cognitive processes such as problem solving, concept formation, pattern learning, etc. Epistemic rules can also be used to integrate various facets of cognitive activities. If we assume that the individual's epistemological hierarchy interacts with the particular task in which he/she is being studied, then that individual's performance will depend upon the match between the nature of the processing required by the task and the epistemic rules of the individual. For example, in tasks such as logical or mathematical reasoning, we might expect an individual with a rationally dominant hierarchy to perform best. But in a task involving primarily analogical reasoning, a metaphorically dominant epistemology might lead to the best performance. Or in the concept attainment or sequential extrapolation tasks often used as psychological

paradigms, an empirically dominant hierarchy, one concerned with repeated patterns of input, may result in best performance.

The assumption in these predictions is that sets of epistemic rules correspond to epistemic styles. Thus, when an individual manifests a particular epistemic style, this corresponds cognitively to the use of certain patterns of rules to process information. This suggests that individual differences in cognitive processing might be explained in terms of differences in rule systems similar to those discussed above. This has been proposed by a number of investigators (e.g., Carroll, 1974; Hunt, 1975; Kearsley, 1976b). Hence, it seems likely that further work which elaborates upon sets of rules corresponding to epistemic styles would contribute to an information processing account of individual differences.

III. WORLDVIEWS AND EPISTEMIC STYLES.

A worldview is defined by Royce (1974a) as: "an organism's set of personal cognitions which constitutes a model or image of reality (i.e., 'the way things are')" (p. 167). As the definition suggests, a worldview comprises the individual's total view of reality. It reflects a commitment to particular underlying epistemologies, ideologies, values, interests, etc. Thus we have scientific worldviews, the worldview of a housewife, a gambler's worldview, etc. The fundamental feature of a worldview is that it encompasses particular modes of organizing knowledge and experience which in turn influence the manner in which subsequent knowledge is sought and valued.

The idea of a worldview has been developed in some detail by a number of authors. In the following account, the ideas of Pepper (1942) and Churchman (1971) are discussed and the three epistemic styles used as a basis for comparison. The intent of these comparisons is to show how the three epistemic styles can be used as integrating constructs in the discussion of worldviews.

Pepper (1942) has proposed the notion of "world hypotheses" which are based on one of four basic "root metaphors" about reality: formism, mechanism, contextualism, and organicism. Each of these four root

metaphors involves different and autonomous categories of judgement and evaluation:

Formism. The root metaphor of formism is similarity, that is, judgements in which the norm transcends the particulars. The theory of truth associated with formism is a correspondence theory where truth consists of similarity between two or more things.

Mechanism. The root metaphor of mechanism is a machine and the primary and secondary qualities associated with spatio-temporal,causal events. The form of truth underlying mechanism is a causal nominalism which gives us a description of causal relationships.

Contextualism. The root metaphor here is the historic event or act in context. The appropriate truth theory is pragmatism in which truth is based on "workability" or successful functioning.

Organicism. The organism is the root metaphor of this world hypothesis. It involves the hypothesis that the world consists of organic processes and structure. The underlying truth theory is a coherence theory in which truth is an organic relatedness of material facts.

Each of these four root metaphors provides the structural basis for making judgements and weighing evidence. That is, they provide frameworks to organize current knowledge and to direct inquiry. To quote Pepper (1966):

> When anyone has a problem before him and is at a

> loss how to handle it, he looks about in his available experience for some analogy that might suggest a solution. This suggestive analogy gives rise to an hypothesis which he can apply towards a solution. The method of development of world hypotheseses follows, I find, the same procedure. The originating analogy, I have called the root metaphor of a world hypothesis.The analysis of the root metaphor generates the categories of the hypothesis. The adequacy of the hypothesis then depends on the capacity of the categories to render interpretations of the features of our world with precision and unrestricted scope. (p. 3)

For Pepper, then, the root metaphors underlying different world hypotheses are most fundamental for their hypothesis generation qualities.

Pepper's four root metaphors can be linked to the three epistemic styles. According to Pepper's analysis, Formism is associated with a correspondence theory of truth which would be the same as an empirical epistemic style. For Pepper, organicism is based upon a coherence theory of truth and thus it could be paired with a rational epistemic style. Neither contextualism nor mechanism match up with a metaphorical epistemic style in terms of the truth theories that Pepper associates with them (pragmatism and causal-nominalism, respectively).

However, if instead of accepting Pepper's analysis, we allign Formism with a rational epistemic style and Mechanism with an empirical epistemic style (both of which can be plausibly argued), then it is possible to associate a metaphorical epistemic style to the root metaphor of Organicism on the basis of its wholistic character.

Now let us compare Churchman's (1971) proposals. Churchman suggests five archetypal inquiring systems (IS) as the basis for different modes of acquiring knowledge. These five are:

Leibneizian IS. This is a formal, deductive, symbolic system concerned with the construction of "fact nets". The associated truth criterion[5] is that of coherence, i.e. consistency and completeness.

Lockean IS. The Lockean system builds an empirical, inductive, redundant representation. The truth criteria are consensual agreement and replicability.

Kantian IS. This IS is a multi-method synthetic system which attempts to construct alternative representations for any given "fact net". A Kantian IS combines both Lockean and Leibneizian IS. It is a model-builder. The truth criterion is actually the multiplicity of models.

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5. Churchman uses the idea of a guarantor of validity rather than truth criteria, however the two are essentially identical.

Hegelian IS. Hegelian IS is a conflictual synthetic system which always attempts to construct completely opposed representations of the same "fact nets". The appropriate truth criteria are the dialectic or the degree of transcendence achieved by the synthesis of the two opposing models.

Singerian IS. The Singerian IS is based upon a system which values progress and process. A Singerian system attempts to refine and revise its models and "fact nets". The truth criterion of a Singerian IS is a pragmatic one since truth is relative to the overall object of inquiry.

For a given problem, each of these Inquiring Systems would build a different representation or model because of differing primitive units and operations. Thus the resulting information gathered is a function of the nature of the inquirer and the particular inquiring processes employed.

There are fairly clear-cut relationships which can be drawn between two of Churchman's IS and epistemic styles. A Leibneizian IS involves a rational epistemic style and a Lockean IS is based upon an empiricial epistemic style. However, none of the three other IS, Kantian, Hegelian, or Singerian, seem to match a metaphorical epistemology (although a Kantian IS with an emphasis om multiple representation seems closest). The lack of an obvious

metaphorically-based IS may be due to Churchman's (explicitly acknowledged) concern with the domain of scientific inquiry.

Thus it is possible to build a theoretical link between Pepper's idea of world hypotheses and Churchman's concept of inquiring systems via the constructs of epistemic styles. Furthermore, epistemic styles, which underlie worldviews, should reflect any behavioral consequences of worldviews in terms of either Pepperian hypothesis generation or Churchmanian inquiry processes. To demonstrate this, it is necessary to show empirical relationships between epistemic styles and some indicator of psychological worldviews.

What differences do worldviews make? Consider the realm of science. Differences in individual worldviews influence the exact type of inquiry engaged in and the methodological approaches which are espoused. For example, Zvegintzev (1972) discusses the differences between empirically-oriented and rationally-oriented approaches to linguistics. Klausner (1966) dicusses how personality correlates of rationalism and empiricism affect scientific conduct. Mitroff (1974) has studied differences in the research activity of Apollo moon scientists in terms of Jungian types. It soon becomes clear that there is no such thing as a general "scientific worldview" but the

differing worldviews possessed by subgroups of scientists. On the other hand, relative to artists, they would have much more dominant rational or empirical epistemologies.

Worldviews are cognitively economical. They provide a framework in which worldly events can be interpreted with minimal mental effort. Without something such as a worldview, each newly occurring event would need to be understood as a point in isolated space with no continuity between past and present knowledge. New information which does not mesh with previous knowledge (according to the particular mode or criteria of some worldview) in fact causes inconvenience, annoyance and perhaps discomfort. Finally, a worldview allows an individual to attend to a mere fraction of all possible events and occurrences. For a limited channel information processing system in an information rich environment , this is a matter of survival.

Then again, worldviews bring with them hazards and disadvantages. They establish communication barriers when concepts which are firmly rooted in one worldview are discussed in another. Thus, worldviews which are strongly dominated by one particular epistemological outlook are "encapsulated" (Royce, 1964). As Pepper (1966) has argued:

It is almost impossible for one immersed in any

> single world theory not to believe that the basic items of cognition as interpreted by the categories of that theory, are in the nature of things cognitively certain. This is the more insidious because it is a fact that if that world theory were fully adequate, these items would be certain--that is, they would indeed be cognitively ultimate. (p. 4)

Worldviews are pervasive characteristics of individual cognition for they comprise an individual's total view of reality. Of course, worldviews cannot be measured in their totality, but must be inferred from objective or observable indicators such as values, interests, preferences, etc. Typically sets or classes of values (e.g., political, religious, moral, etc.) or preferences (e.g., food, sexual, colour, etc.) are lumped together as predictive entities. Thus, someone with "liberal" political values is likely to manifest certain expected attitudes towards political matters. We can also pick a specific indicator. For example, regular readership of the Financial Post can be taken as an indication of certain financial or business interests or values and reflect one component of a worldview. The more long-term, encompassing, or established the indicator, the better the reflection of the dominant themes of an individual's worldview. According to this reasoning, two good

indicators of worldviews would be a commitment to a particular academic discipline or vocational interests in that these both reflect long-term and encompassing interests and preferences. Thus, if we are interested in relating underlying epistemic styles to worldviews, we can relate epistemic styles (as indicated by the PEP) to indicators of academic specialization and vocational interests.

Epistemic Styles and Academic Specialization

It is presumed that in selecting a particular discipline, the dominant epistemology underlying that discipline is shared by the individual. Thus we would expect that the profiles of individuals in different disciplines would show characteristic epistemologies and worldviews. This was demonstrated by Smith et al. (1967) in which the PEP was given to professionals in the disciplines of mathematics-philosophy, geophysics, experimental psychology, and speech-drama. As expected, the mathematics-philosophy group had its highest score on rationalism, the experimental psychologists had an empirically dominant hierarchy, and the speech-drama group scored highest on metaphorism. (This data is presented in Royce et al., 1975, p. 22).

A similar study was repeated using a later form of

the PEP with graduate students in different disciplines. The interest in this study was to confirm the results of the earlier study, to investigate the degree of encapsulation for graduate students, and to assess a wider range of disciplines. The data from this study are presented in Table 4. As can be seen from this table, the three humanities had the highest scores on metaphorism, the four analytic sciences (mathematics, philosophy, theoretical physics, theoretical chemistry) had their highest score on rationalism, and the two life sciences (botany and zoology) had the highest scores on empiricism. Note that this is true on both a relative basis (i.e., within a particular group) and on an absolute basis (i.e., between all groups).

These data indicate that while the dominant commitment comes out as expected for a general domain of study, there are differences in the group epistemological profile for particular disciplines. For example, mathematicians come out clearly higher on rationalism than any of the other epistemologies; however, philosophers are highest on rationalism but also high on metaphorism. This suggests that particular disciplines may be characterized by a particular epistemological profile. Furthermore, it is possible that while a particular discipline has a characteristic dominant epistemological hierarchy, subgroups within the discipline have other hierarchies.

Thus, for example, we might expect mathematical psychologists to have a rationally dominant profile, experimental psychologists to have an empirically dominant hierarchy, and humanistic psychologists to have a metaphorically dominant epistemology. If this were the case we might expect a mathematical psychologist to have a worldview closer to that of a mathematician or philosopher than to an experimental psychologist.

These data show that epistemic commitments have been made at the stage of graduate study. It is conceivable that such encapsulation takes place during undergraduate instruction or earlier. In order to see if any differences were evident at the level of first year undergraduates, data collected from another study were analyzed with respect to faculty of enrolment. These data are presented in Table 5. As can be seen, the only significant difference in scores is the lower score on empiricism for students enrolled in arts. These data suggest that no strong epistemic commitments have been formed at the beginning stage of university study but have been by the stage of graduate study.

Epistemic Styles and Vocational Interests

The relationships between epistemic styles and domains of academic specialization demonstrated above are

an important but limited indication of differences in psychological worldviews. A more general indication is that provided by the relationships between epistemic styles and vocational interests. When an individual expresses attitudinal preferences for a certain vocation, it can be assumed that this choice reflects an acceptance of the basic orientation and model of reality provided by such a vocation.[6] Thus, an individual indicating an interest in artistic professions is presumably reflecting an acceptance of the values, interests, preferences, etc. of artistic endeavors and inquiry and its ensuing epistemology. For this reason, it is expected that an individual with a metaphorically dominant epistemological hierarchy would indicate strong vocational interest in artistic vocations. Similarly, it is expected that individuals with empirically or rationally dominant hierarchies would select "empirical" or "rational" vocations. An attempt to demonstrate these relationships between epistemic styles and vocational interests was the purpose of the following study.

The PEP was administered to 40 first year university students (20 male; 20 female) and followed by the Strong

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6. The emphasis is deliberately placed upon the indication of a vocational <u>preference</u> . The actual vocation that an individual chooses or winds up in is of course dependent upon unpredictable circumstantial and situational variables.

Vocational Interest Blank (SVIB). The SVIB has separate items and scales for men and women. The current SVIB (see Campbell, 1971, for details) has three sets of scales; the basic interest scales (22 for men and 19 for women); the non-occupational scales (8 for men, 4 for women); and the occupational scales (54 for men, 58 for women). The basic interest scales indicate general categories of interests (e.g., public speaking, nature), the non-occupational scales indicate occupationally relevant personality dimensions (e.g., leadership), and the occupational scales indicate interests similar to individuals in specific vocations (e.g., sales manager).

The correlations between the three PEP scales and the interest and non-occupational scales of the SVIB are shown in Table 6 for men and Table 7 for women. Referring to Table 6 first, it can be seen that the strongest correlations are obtained between metaphorism and artistic interests (music, art, writing). The rationalism scale has low positive correlations with business-related interests (business management, sales, merchandising, office practices) and recreational leadership, while metaphorism and empiricism have consistent negative correlations with these interests. The empirical scale shows no strong correlations or distinctive patterns for the men's interest scales except for a moderately positive negative correlation with a mathematics interest. As far as the

men's non-occupational scales are concerned, metaphorism shows moderate positive correlations with academic achievement (AACH), age-relatedness (AR), and a moderate negative relationship with intellectual masculinity/femininity (indicating a tendency towards "feminine" interests).

Turning to the women's interest scales (Table 7), we again see moderate positive correlations between metaphorism and artistic interests (music,art, performing arts, writing). However, artistic interests have moderate positive correlations with empiricism. The empirical scale shows higher positive correlations with physical, biological, and empirical science interests than either of rationalism or metaphorism. All three PEP scales show a moderate positive correlation with a public speaking interest. With respect to the non-occupational scales, academic achievement is most highly correlated with empiricism (rather than metaphorism as for men). All three PEP scales show moderate negative correlations with occupational introversion/extroversion (indicating that a high score on any PEP scale corresponds to a person-oriented rather than thing-oriented interest).

The correlations for the vocational scales are given in Table 8 for men and Table 9 for women. Considering the correlations for the men's scales, there are moderately

positive correlations between the metaphorism scale and the vocations of Group VI (librarian, artist, musical performer, music teacher). The correlations for rationalism are slightly negative or positive for the business-related vocations of Group VIII and Group XI whereas all the correlations with metaphorism and empiricism are moderately negative. The correlations of the empirical scale with the science-related Group I professions are small but positive.

Looking at the women's vocational scales (Table 9), it can be seen that metaphorism shows moderate positive correlations with those vocations of of Group I and II (music teacher, art leader, interior decorator, etc.). The empirical scale shows low positive correlations for all of the Group VI science-related professions while most of the correlations with the other scales are consistently negative. There seem to be no strong differences in women's vocational interests which distinguishes the rational scale from the others.

Taken together the correlations between the PEP and the SVIB scales suggest that there are certain vocational interest patterns associated with epistemic styles. This is most consistently shown with respect to the correlations between metaphorism and artistically related vocations. There is weaker evidence that empiricism is

associated with science-oriented vocational interests. The relationship between rationalism and business-related vocational interests was unexpected but not puzzling. It seems reasonable that the modern rationalist may find satisfaction with a worldview that stresses the logic of economical and financial matters and which is based upon the concept of a 'rational man'. It is rather surprising though that rationalism should consistently correlate negatively with mathematical vocational interests. This suggests that mathematics (at least as a vocation) may not be so clearly "rational" as measured by the PEP scale.

These data reveal clear sex differences in terms of the relationships between epistemic styles and vocational interests. For almost all men's scales, the three PEP dimensions show quite different patterns of vocational interests. Thus, for any one vocational scale, each of the three PEP scales gives a different correlation. However, in the case of the women's vocational scales, many have essentially the same correlations with all three of the PEP scales. This suggests that for women, epistemic styles do not show a differentiating effect for different types of vocational interests. This may reflect the historical lack of vocational choice available to women (which with current liberalization of women's social roles can be expected to change in the future).

To summarize the empirical findings reported in this chapter, it has been illustrated that epistemic styles are clearly evident in the case of commitments to academic disciplines, even as early as graduate study. Epistemic styles also seem to underlie vocational interests although the patterns of relationship are fairly complex. These empirical demonstrations show how differences in psychological worldviews, as reflected by epistemic styles, may have major influences on the course of an individual's life and career.

IV. CONCLUSION.

The preceding studies serve to elaborate upon the empirical and theoretical basis of psychological epistemology. On the theoretical side, an attempt was made to compare two notions of worldviews which have been proposed, and the construct of epistemic rule was introduced to explore the cognitive processes which correspond to epistemic styles. On the empirical side, two studies investigated the relationships between epistemic styles and academic specialization, and vocational interests.

While these studies contribute to the development of psychological epistemology, the available empirical research to date is minimal. One of the many studies which needs to be undertaken is to investigate the relationships between epistemic styles and cognitive styles/abilities from a multivariate perspective. A beginning in this direction has been made by Mos, Wardell & Royce (1974) but a more systematic approach is required. Of particular interest would be a study which investigated likely cognitive correlates of epistemic styles using individuals who are very high or low on each of the epistemic styles. It would be expected that individuals high on empiricism would show the best performance on perceptual ability/ style tests; rationally dominant individuals would do best

on conceptual-reasoning tests; and metaphorically dominant individuals would do best on tests tapping symbolic-intuitive abilities/styles. Similarly, we would expect individuals low on each of the epistemic styles to do poorer on one type of test rather than the others. A study which included both abilities and styles might also shed some light on the poorly understood relationship between cognitive abilities and styles.

Another theoretical-empirical question of interest pertains to the ontogenetic development of epistemic styles. A reasonable hypothesis is that epistemic commitments vary with age. The present evidence suggests that individuals manifest an even more dominant epistemology later in life than earlier. However, it also seems plausible that there are characteristic shifts in epistemological hierarchies over the life span. Thus, the correlation between metaphorism and the age-related scale of the men's SVIB hints at the possiblity that metaphorism changes with age. The suggestion here is that a tendency towards metaphorism may be chraracteristic of later adulthood while, say, rationalism may be more characteristic of youth.[7] This question could be empirically investigated by a life-span study of epistemic

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7. A different developmental pattern would be expected for women.

styles.

Another line of exploration which would be of some interest would be the exploration of socio-cultural variables and epistemic styles. Thus, in addition to the likely differences between cultures with respect to differing characteristic epistemologies, it seems plausible that variables such as social class, economic status, political orientations, etc. may be associated with certain epistemologies. Such a line of inquiry would build a link between psychological and sociological epistemology.

Although the concern in this thesis is upon basic research, there are significant implications for applied fields, e.g., vocational guidance and selection, psychotherapy, and education. The usefulness of epistemic styles to vocational guidance or selection is illustrated by the relationship between epistemic styles and vocational interests reported in the previous chapter. It seems likely that the appropriateness of an individual's epistemological hierarchy for a selected vocation may be an important factor in vocational success or satisfaction. For example, it might be the case that an individual with a strongly metaphorical epistemology would be unsatisfied with or unsatisfactory for a business-oriented vocation. Along the lines of this suggestion is the work of

Baumgarder (1976), who has shown that analytic-intuitive orientations in undergraduates strongly affect their career decisions.

With respect to psychotherapy, we might expect interactions between patient and therapist epistemic styles to be important in the eventual success of therapy. Perhaps an empirically dominant patient will respond better to an empirically dominant therapist. Or it is possible that certain types of therapy are more likely to be successful with certain epistemological hierarchies than others. Preliminary data pertaining to these hypotheses has been reported by Zelhart & Wargo (1971).

Education provides the most likely and possibly important application of epistemic styles. In so far as graduate students have definite epistemological commitments (as demonstrated in the previous chapter), epistemic styles may be useful as graduate selection or counselling criteria. More generally, it seems reasonable that a match or mismatch between a student's epistemological hierarchy and that of the subject matter studied may be of some importance in terms of academic success or satisfaction. Furthermore, an epistemic match/mismatch may be important in terms of the <u>way</u> in which a particular subject matter is presented. Thus an individual with a rationally dominant epistemology may

prefer or do better with a well-structured, formal course organization whereas a metaphorically dominant individual may prefer or perform better with an unstructured cirriculum. Evidence for such differences have been demonstrated by Pask & Scott (1972) for differences between wholists and serialists.

Needless to say, all of these suggestions regarding possible applications of psychological epistemology are only speculative and would need to be established by adequate empirical research. It may be the case that epistemic styles are too global to have very specific consequences for applied areas. On the other hand, research to date suggests that the pervasiveness of epistemic styles on an individual's behavior extends across most life situations.

This thesis has focused on the psychological study of epistemology, i.e., the way individuals differ in their ways of knowing and a description of the process of knowing. This can be contrasted with the traditional philosophical study of epistemology which concerns itself with the evaluation of the validity of knowledge claims. However, epistemology can be studied from other perspectives. Computer and information sciences study epistemology from the perspective of the design of knowledge systems. Sociology focuses on the effects of

political, economic, and cultural differences in the development and transfer of knowledge. By virtue of these differing perspectives, each discipline contributes to different aspects of the study of knowledge. For example, a sociological epistemology would teach us that the study of epistemology itself is historically and culturally bound and destined to change with social, economic and political forces. Thus, a psychological epistemology must recognize these sociological limitations upon its own particular perspective. Indeed, the research and theory presented herein is bound to such a historical and cultural framework. It is reasonable to conclude that the study of epistemology from a number of different perspectives will ultimately lead to a more complete and adequate understanding of knowledge--its nature, origins, and limits.

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APPENDIX.

This appendix reports the results of a "faking" experiment done with the PEP to evaluate its face validity. Although it is assumed that subjects try to respond as honestly as possible under standard test adminstration conditions, it is useful for purposes of test interpretation to be aware of the effects of "faking" responses.

The PEP (Form VI) was administered to four randomly selected groups of introductory psychology students who were participating in the experiment for course requirements. All four groups completed the PEP according to the usual instructions, then after a short interval, given the test again. One group was given the the standard instructions again (control group); the second group was instructed to answer the inventory "imagining they were a writer, musician, or artist and most concerned with creative expression and symbolic significance" (metaphorical fakers); the third group was instructed to "imagine they were a mathematician or logician most concerned with logical consistency and rational thought" (rational fakers); and the fourth group was instructed to "imagine they were a biologist or anthropologist and most concerned with observing things and describing what can be seen" (empirical fakers).

The means and standard deviations of the scores for each of these four groups on the initial administration (I) and the second "faked" administration (F) are given in Table 10. First of all, there were no significant differences between the first and second administration for the control group indicating that there were no effects attributable to simply taking the test twice. Secondly, the mean scores for each of the faking groups was highest on the appropriate scale. However, with the exception of the rational scale for the metaphorical fakers, scores on the other scales also changed significantly under the faking conditions. Thus, faking metaphorically raised the score on the metaphorical scale and lowered the score on the empirical scale; faking rationally raised the scores on both the rational and empirical scales and lowered the score on the metaphorical scale; and faking empirically also raised the scores on both the empirical and rational scales and lowered the mean score on the metaphorical scale.

The effects of faking on epistemological hierarchies are shown in Table 11. In each of the faking groups, with one exception, all of the individuals changed their hierarchy to reflect the faked epistemology as dominant. However, these changes did not distribute themselves equally between the two possible hierarchies for each

faked dimension, but tended to load on one of the possible hierarchies: MRE, REM, or ERM. While this may be an artifactual outcome due to small sample size, it seems clearly consistent across all three faking groups. It is possible that these particular hierarchies correspond to the particular reference groups given in the faking instructions. These data suggest that individuals can adopt a non-characteristic worldview, if instructed. Thus, manifestation of a particular worldview or epistemic style is a matter of preference rather than necessity.

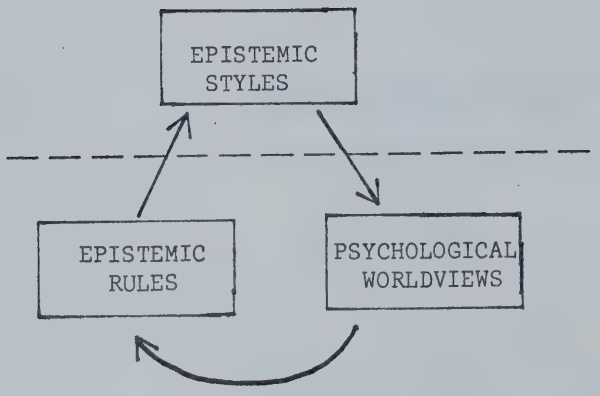

Figure 1. The theoretical relationship between the constructs of epistemic styles, rules, and worldviews.

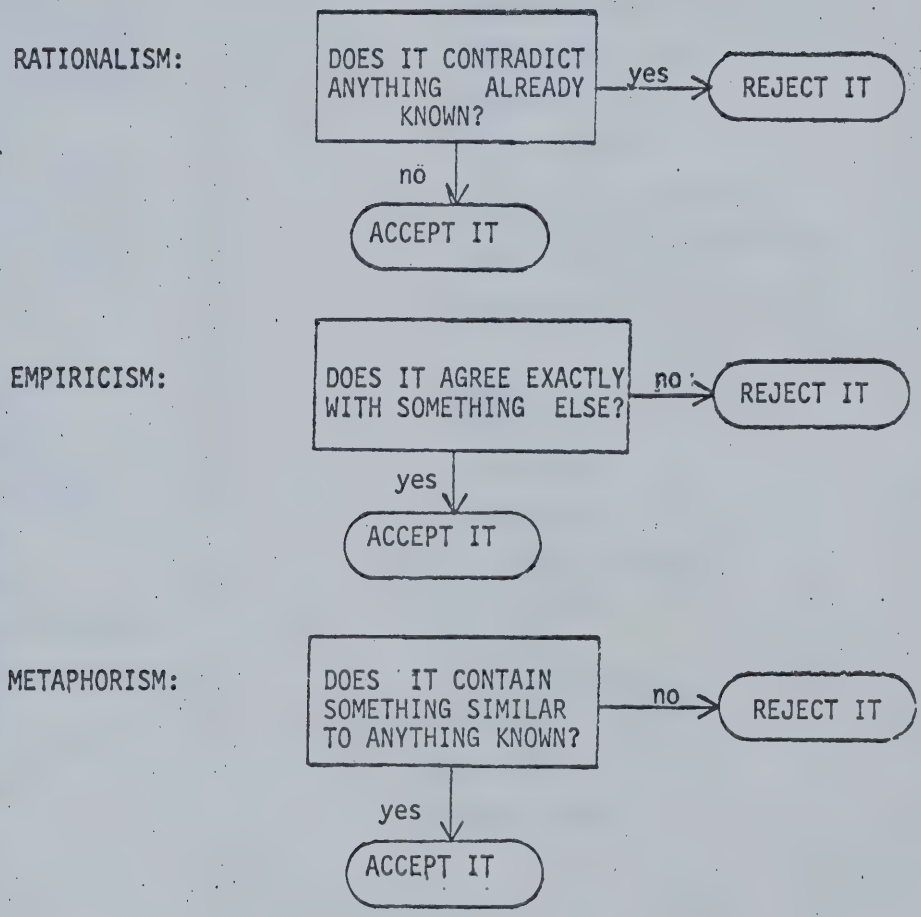

Figure 2. Three epistemic rules corresponding to the three epistemic styles.

TABLE 1

The Five Sets of Sentences Used in the Experiment.

SET 1

SOPS WOGGE.
GREPS ARE DRILD.
CAMONS GRUND.
DRILD REMEL GREPS.
GREPS ARE NOT DRILD.
GREPS PELP.
SOPS DON'T WOGGE.
DOLDS FLIS.
GREPS ARE DRILD.
DRILD PELP.

SET 2

TOVES DON'T GIMBLE.
VORPALS ARE BOROGROVES.
VORPALS ARE NOT BOROGROVES.
TOVES DON'T GIMBLE.
BOROGROVES WABE.
RATHS WHIFFLE.
VORPALS ARE BOROGROVES.
VORPALS ARE NOT BOROGROVES.
TOVES GIMBLE.
MAXOMES FRUP.

SET 3

WUMPS DUDDLE.
TORBS DUDDLE.
TORBS ARE GRUDDLY.
LUDS RILL.
TORBS DUDDLE.
GRUDDLY MAMO DUDDLE.
WUMPS DUDDLE.
TORBS DUDDLE.
TORBS ARE GRUDDLY.
WUMPS DUDDLE.

SET 4

RASPS PORL.
JUNTS SMIK.
YILS TRUNGLE.
VAX DON'T TRUNGLE.
YILS TRUNGLE.
VAX PORL.
YILS ARE NOT RASPS.
VAX PORL.
VAX PORL.
AURIBS FLEEP.

SET 5

VRILLO NUBE BUNX.
MAKS ARE VRILLO.
TROPS FURB.
ZUMS DON'T BANGLE.
MAKS BUNX.
MAKS ARE NOT VRILLO.
SARPS HING.
VRILLO BARD MAKS.
MAKS ARE VRILLO.
ZUMS BANGLE.

TABLE 2

The sentences of set 4 as rearranged by the program for the six epistemological hierarchies.

HIERARCHY IS E R M
REORGANIZED LIST IS
(VAX PORL)
(VAX PORL)
(VAX PORL)
(YILS TRUNGLE)
(YILS TRUNGLE)
(RASPS PORL)
(YILS ARE NOT RASPS)
(JUNTS SMIK)
(VAX DONT TRUNGLE)
(AURIBS FLEEP)

HIERARCHY IS E M R
REORGANIZED LIST IS
(VAX PORL)
(VAX PORL)
(VAX PORL)
(YILS TRUNGLE)
(YILS TRUNGLE)
(RASPS PORL)
(YILS ARE NOT RASPS)
(JUNTS SMIK)
(VAX DONT TRUNGLE)
(AURIBS FLEEP)

HIERARCHY IS M E R
REORGANIZED LIST IS
(YILS TRUNGLE)
(YILS TRUNGLE)
(YILS ARE NOT RASPS)
(VAX PORL)
(VAX PORL)
(VAX PORL)
(RASPS PORL)
(VAX DONT TRUNGLE)
(JUNTS SMIK)
(AURIBS FLEEP)

HIERARCHY IS M R E
REORGANIZED LIST IS
(YILS TRUNGLE)
(YILS TRUNGLE)
(YILS ARE NOT RASPS)
(VAX PORL)
(VAX PORL)
(VAX PORL)
(RASPS PORL)
(VAX DONT TRUNGLE)
(JUNTS SMIK)
(AURIBS FLEEP)

HIERARCHY IS R E M
REORGANIZED LIST IS
(VAX PORL)
(VAX PORL)
(VAX PORL)
(YILS TRUNGLE)
(YILS TRUNGLE)
(RASPS PORL)
(YILS ARE NOT RASPS)
(JUNTS SMIK)
(VAX DONT TRUNGLE)

HIERARCHY IS R M E
REORGANIZED LIST IS
(YILS TRUNGLE)
(YILS TRUNGLE)
(YILS ARE NOT RASPS)
(VAX PORL)
(VAX PORL)
(VAX PORL)
(RASPS PORL)
(VAX DONT TRUNGLE)
(JUNTS SMIK)

TABLE 3

Correlation Coefficients Between the Order of Rearrangement of the Sentences by the Program and Subjects for the five Sets of Sentences.

SUBJECT	EPISTEMOLOGICAL HIERARCHY	SENTENCE SET 1	2	3	4	5
S1	M E R	.5	.8**	.9**	.8**	.0
S2	E M R	.4	.4	.9**	.8**	.4
S3	R M E	-.1	.8**	.6*	.5	.2
S4	M E R	.0	.4	1.0**	.5	.5
S5	M R E	.7*	.4	.9**	.4	.4
S6	M R E	.5	.5	.8**	.6*	.1
S7	M E R	-.1	.9**	.6*	.5	.5
S8	E R M	-.1	.6*	.9**	.5	.3

* $p < .05$

** $p < .005$

TABLE 4

Means and standard deviations of the PEP dimensions for various disciplines (Revised Form VI).

		Metaphorical		Rational		Empirical	
Disciplines	N	Mean	SD	Mean	SD	Mean	SD
Fine Arts	18	110	9.8	93	8.3	97	10.1
Classics	3	112	20.4	112	13.2	104	18.0
English	10	117	9.9	106	6.4	101	6.4
Humanities	31	114*	11.0	101	10.8	99	9.4
Mathematics	17	97	18.9	110	17.6	101	12.6
Philosophy	8	110	4.0	119	6.1	98	7.4
Physics	9	98	13.2	107	15.1	93	16.7
Chemistry	4	101	14.8	114	1.4	103	14.8
Analytic Sciences	38	99	14.8	110*	15.2	97	14.0
Botany	11	98	13.1	100	9.2	104	9.0
Zoology	17	101	10.7	102	11.2	107	9.7
Life Sciences	28	99	12.1	101	9.6	105*	9.1

*significantly different from other two other scores in row or two other combined scores in column at p=.05 by Student-Newman-Keuls Multiple Comparison test.

TABLE 5

Means and standard deviations of the PEP dimensions for various Faculties (Revised Form V).

		Metaphorical		Rational		Empirical	
Faculties	N	Mean	SD	Mean	SD	Mean	SD
Science	48	105.6	11.7	108.0	9.7	105.7	9.4
Arts	28	107.6	14.5	106.8	9.8	99.5*	11.1
Business & Commerce	15	104.1	12.3	110.5	12.3	102.5	11.3
Physical Education	10	104.7	15.0	107.2	10.8	109.6	7.7

*significantly different from other two scores in row at 0=.05 by Student-Newman-Keuls Multiple Comparison test.

TABLE 6

CORRELATION COEFFICIENTS BETWEEN PEP DIMENSIONS (FORM V) AND THE MEN'S INTEREST AND NON-OCCUPATIONAL SCALES OF THE SVIB (FORM 399). N=20.

Interest Scales	Rationalism	Metaphorism	Empiricism
Public Speaking	05	36	01
Law/Politics	-01	-01	-11
Business Management	28	-14	-12
Sales	26	-18	-17
Merchandising	31	-03	-16
Office Practices	27	-12	-21
Military Activities	-18	-17	-19
Technical Supervision	33	-13	-10
Mathematics	-15	-13	-48
Science	13	08	15
Mechanical	12	04	-18
Nature	32	73	34
Agriculture	16	42	13
Adventure	26	32	33
Recreational Leadership	42	01	32
Medical Service	20	20	14
Social Service	20	48	27
Religious Activities	-22	10	-11
Teaching	10	44	15
Music	07	56	28
Art	10	69	22
Writing	04	65	05
Non-occupational Scales			
AACH	10	52	03
AR	03	54	25
DIV	25	39	04
MFII	04	-61	-01
MO	-08	-08	-11
OIE	-38	-32	-16
OL	-26	-23	-41
SL	13	36	08

TABLE 7

CORRELATION COEFFICIENTS BETWEEN THE PEP (FORM V) AND THE WOMEN'S INTEREST AND NON-OCCUPATIONAL SCALES OF THE SVIB (FORM TW398) N=20.

Interest Scales	Rationalism	Metaphorism	Empiricism
Public Speaking	59	70	63
Law/Politics	35	44	55
Merchandising	25	37	25
Office Practices	45	44	10
Numbers	14	23	30
Physical Science	03	20	45
Mechanical	-03	37	39
Outdoors	18	51	45
Biological Science	03	05	31
Medical Service	-08	-06	21
Teaching	47	15	22
Social Service	-06	-07	-10
Sports	25	16	25
Homemaking	-10	-13	-26
Religious Activities	-17	-03	-07
Music	35	52	60
Art	32	60	45
Performing Arts	49	64	71
Writing	45	67	52
Non-occupational Scales			
AACH	02	26	41
DIV	42	48	46
FMII	14	35	11
OIE	-53	-60	-55

TABLE 8

CORRELATION COEFFICIENTS BETWEEN PEP DIMENSIONS (FORM V) AND THE MEN'S VOCATIONAL SCALES OF THE SVIB (FORM T399). N=20.

Group	Vocational Scales	Rationalism	Metaphorism	Empiricism
I	Dentist	-23	03	08
	Osteopath	15	45	36
	Veterinarian	07	-30	03
	Physician	-18	32	27
	Psychiatrist	-05	58	25
	Psychologist	-12	51	21
	Biologist	-20	37	26
II	Architect	-23	02	-01
	Mathematician	-41	04	-10
	Physicist	-30	-02	-11
	Chemist	-19	-02	-03
	Engineer	-25	-31	-27
III	Production	02	-54	-37
	Army Officer	01	-06	-35
	Air Force Officer	10	-12	-14
IV	Carpenter	01	-25	-06
	Forest Service Man	31	-10	23
	Farmer	-11	-49	-18
	Math-Science Teacher	35	-08	13
	Printer	05	-02	-04
	Policeman	12	-08	01
V	Personnel Director	21	07	-12
	Public Administrator	15	11	-12
	Rehabilitation Couns.	22	43	12
	YMCA Staff Member	30	25	30
	Social Worker	14	52	24
	Social Science Teacher	25	14	19
	School Superintendent	-04	18	-14
	Minister	-03	59	09
VI	Librarian	-06	56	18
	Artist	-15	48	19
	Musician Performer	04	44	39
	Music Teacher	-02	45	19
VII	C.P.A. Owner	-30	-35	-53

TABLE 8 (continued)

Group	Vocational Scales	Rationalism	Metaphorism	Empiricism
VIII	Senior C.P.A.	-05	-50	-54
	Accountant	04	-37	-49
	Office Worker	17	-46	-49
	Purchasing Agent	-01	-68	-37
	Banker	-04	-60	-29
	Pharmacist	21	-50	-26
	Funeral Director	-17	-50	-41
IX	Sales Manager	06	-48	-30
	Real Estate Salesman	-18	-61	-32
	Life Ins. Salesman	-06	-34	-11
X	Advertising Man	-40	-05	-24
	Lawyer	-50	-02	-11
	Author-Journalist	-43	14	-09
XI	President-Mfg.	-09	-49	-50
	Credit Manager	30	-12	-13
	Chamber of Com. Exec.	26	12	-08
	Physical Therapist	31	41	35
	Computer Programmer	05	03	-15
	Business Ed. Teacher	35	-11	-09
	Community Rec. Admin.	37	21	18

TABLE 9

CORRELATION COEFFICIENTS BETWEEN PEP DIMENSIONS (FORM V) AND THE WOMEN'S VOCATIONAL SCALES OF THE SVIB (FORM TW398). N=20.

Group	Vocational Scales	Rationalism	Metaphorism	Empiricism
I	Music Teacher	50	35	37
	Entertainer	37	45	54
	Musician Performer	38	48	53
	Model	09	09	03
II	Art Teacher	27	45	43
	Artist	-24	-12	04
	Interior Decorator	21	45	32
III	Newswoman	24	39	46
	English Teacher	44	49	34
	Language Teacher	35	29	20
IV	YWCA Staff Member	60	56	57
	Recreation Leader	52	40	39
	Director, Christian Ed.	10	10	-12
	Nun-Teacher	-23	35	19
	Guidance Counselor	52	34	37
	Social Science Teacher	39	40	39
	Social Worker	57	52	61
V	Speech Pathologist	41	24	53
	Psychologist	22	26	56
	Librarian	25	51	50
	Translator	26	41	63
VI	Physician	-09	01	29
	Dentist	-18	-06	09
	Medical Technologist	-19	-13	15
	Chemist	-06	00	32
	Mathematician	-16	-14	13
	Computer Programmer	-26	-08	18
	Math-Science Teacher	-41	-42	29
	Engineer	-06	26	42
VII	Army-Enlisted	-14	00	14
	Navy-Enlisted	-48	-45	-35
	Army-Officer	40	50	60
	Navy-Officer	24	34	48

TABLE 9 (continued)

Group	Vocational Scales	Rationalism	Metaphorism	Empiricism
VIII	Lawyer	40	57	65
	Accountant	16	43	40
	Bankwoman	33	40	18
	Life Ins. Underwriter	38	32	44
	Buyer	12	22	08
	Business Ed. Teacher	14	-01	-30
IX	Home Econ. Teacher	07	-01	-22
	Dietitian	14	11	44
X	Physical Ed. Teacher	-48	-59	-46
	Occupational Therapist	19	30	17
	Physical Therapist	-11	-11	17
	Public Health Nurse	09	-33	-14
	Registered Nurse	03	-16	12
	Lic. Practical Nurse	-12	-27	-10
	Radiologic Technologist	-21	-15	09
	Dental Assistant	-13	-42	-36
XI	Executive Housekeeper	29	30	-04
	Elementary Teacher	-14	-02	-14
	Secretary	08	-03	-34
	Saleswoman	-17	25	-09
	Telephone Operator	-08	-18	-38
	Instrument Assembler	-42	-60	-61
	Sewing Mach. Operator	-29	-34	-51
	Beautician	-30	-48	-57
	Airline Stewardess	39	41	41

TABLE 10

Means and standard deviations of the PEP dimensions for different response biases (Revised Form VI).

		Metaphorical		Rational		Empirical	
Response Bias		Mean	SD	Mean	SD	Mean	SD
Metaphorical	I	105.7	10.1	104.2	7.6	101.3	11.5
N = 20	F	131.7	9.1	102.7	13.3	91.9	16.3
Rational	I	106.9	13.6	107.6	10.3	105.2	9.9
N = 21	F	87.3	18.3	127.9	10.8	120.0	10.0
Empirical	I	100.3	12.4	100.8	8.1	100.7	9.4
N = 23	F	88.1	17.3	115.7	12.0	129.6	8.0
Control	I	103.6	9.8	102.7	10.1	100.3	7.5
N = 30	F	103.7	9.9	102.5	9.6	100.3	8.9

TABLE 11

Number of subjects with each epistemological hierarchy for different response biases (Revised Form VI).

Response Bias		MRE	MER	RME	REM	EMR	ERM
Metaphorical	I	8	3	4	0	1	4
	F	16	4	0	0	0	0
Rational	I	8	1	2	6	1	4
	F	0	0	3	18	0	0
Empirical	I	1	5	5	6	5	1
	F	0	0	0	1	1	21
Control	I	8	5	2	6	4	5
	F	11	3	4	5	2	6

I = initial administration, F = second "faked" administration